RECEIVED
CENTRAL FAX CENTER
JAN 11 2007

REMARKS

Reconsideration and allowance of the above-identified application is respectfully requested. Supportive discussion regarding this is given below.

The present invention is directed to a semiconductor integrated circuit chip in which, among the featured aspects thereof, a circuit forming layer, on which a plurality of circuits are formed, is formed on one surface side of a plate-like semiconductor chip, and a heat transfer layer, connected with a plate-like semiconductor chip in one body, is formed in an opposing surface side of the plate-like semiconductor chip, examples of which are shown in Figs. 4 with 5(A)-5(B) and, also, in Fig. 1 of the drawings, although various modifications thereof are also disclosed including with regard to Figs. 6 and 7, etc. The particularities thereof are set forth in independent claim 4 as well as in the corresponding dependent claims 5-13 thereof as well as with regard to independent claim 14. In accordance with the invention, also, suppression of localized increases in temperature (e.g., hot spots) is achieved in semiconductor integrated circuit chips such as ones that contain different types of circuits, which have different power requirements and/or different heat generating distribution characteristics within the same chip such as between circuits of a memory and that of a computation circuit portion such as with regard to both a memory and a CPU located within the same chip, as an example thereof, although numerous others are applicable herein.

In accordance with the present invention, for example, a local increase of temperature caused by heat generation of circuits within the circuit forming layer of the chip, during operation thereof, is suppressed. In this regard, the invention according to independent claim 4 sets forth a heat transfer layer in

the chip, i.e., connected with the plate-like semiconductor chip in one body, on the surface side of the chip opposite the side thereof on which the circuit forming layer is formed, the heat transfer layer comprising, in an inside thereof:

a closed flow passage;
an operating fluid hermetically enclosed within said closed flow passage; and
driving means of said operating fluid,
wherein said driving means of the operating fluid is made of means for giving vibration to said operating fluid which is hermetically enclosed within said closed flow passage,
wherein said heat transfer layer is made of a material similar to that of said semiconductor chip, and
wherein the vibration giving means includes a resistor layer.

In the example embodiment shown by Fig. 4 with Figs. 5(A)-5(B) of the drawings, a localized rise in temperature in the electric circuit forming layer is suppressed by the heat transfer that is effected through control action of the hermetically enclosed fluid (e.g., operating fluid 4) in the passage ducts which are, in this example, driven and/or operated substantially individually or independently by the "driving means" of the operating fluid, the driving means being made of means for giving vibration to the operating fluid which is hermetically enclosed within the closed flow passage, the vibration giving means including a resistor layer. Reference numeral 5 in Figs. 4 and 5 represents a resistor layer for building up the driving means of the operating fluid 4, as one example thereof. As can be seen from these illustrations, the heat transfer layer, which contains the closed flow passage, the operating fluid that is hermetically enclosed within the closed flow passage as well as the vibration giving means which includes a resistor layer, is constituted together with the chip in one body. Regarding the example Figs. 4-5 embodiment, the details of the structure thereof is given from page 10, line 29,

to page 13, line 9, and description regarding the transferring (diffusing) function of the heat generation in the integrated circuit, as it relates to the example Figs 1 and 5 embodiments is given beginning on page 15, line 26, of the earlier submitted Substitute Specification. With regard to the example Fig. 1 embodiment, unlike the structure shown in Figs. 5(A) and 5(B), the resistor films are formed on the lower side surface of the passage ducts 3 (e.g., see resistor layer 12 in Fig. 1).

Independent claim 14 similarly calls for a semiconductor integrated circuit chip which features a heat transfer layer comprising a closed flow passage, an operating fluid hermetically enclosed within the closed flow passage and driving means of the fluid which is made of means for giving vibration to the fluid (which is hermetically enclosed within the closed flow passage), the vibration giving means including a resistor layer. The example embodiment shown in Fig. 1 of the drawings, although not limited thereto, is illustrative of this.

As can be seen from Fig. 1, layer 2 is a circuit forming layer that is formed on one surface side of the chip and the heat transfer layer is represented by (i) the flow passage (or heat diffusing) layer 15, (ii) passage ducts 3, and (iii) layers 12-14, 12 being the resistor layer of the vibration giving means. The Fig. 1 example embodiment is discussed on page 13, line 10 to page 15, line 25, of the Substitute Specification, although not limited thereto, and additional discussion thereof regarding its operation is given beginning on page 15, line 26, of the Substitute Specification.

The various structural aspects featured in the dependent claims are also covered in the related description of these example embodiments,

although not limited thereto. For example, the set forth aspect calling for a "temperature detecting means" is discussed in connection with the example embodiment shown in Figs. 4-5 of the drawings (e.g., see temperature sensor 7 and related discussion), although not limited thereto. It is submitted, the invention defined in claims 4-13 and 21 as well as that covered by independent claim 14, it is submitted, defines over the art, as applied in the outstanding rejections.

I. Rejection of Claims 4-9, 11, 12, 14, and 21 under 35 USC § 103(a) over the Combination of Zuo (U.S. Patent 6,631,077) in view of the published article Microchip Fabrication (by P. Van Zant)

The invention according to independent claim 4 or independent claim 14 calls for integrating or building up a cooling system within the semiconductor integrated circuit chip for the purpose of circulating the coolant, namely, the operating fluid that is hermetically enclosed within a closed flow passage such that a local increase of temperature (e.g., a hot spot) that is caused by heat generation of circuits during operation thereof, which are formed in the circuit forming layer of the semiconductor chip, is suppressed. In this regard, the present invention calls for a heat transfer layer in the chip (or unitized with the chip) that features a driving means including a resistor layer for giving a vibration to the operating fluid (see the last line in both independent claim 4 and independent claim 14). In other words, it is not as a result of mechanical means but rather strictly through electrical means such as a resistor layer (e.g., resistor layer 5 in Figs. 4 and 5(A)-5(B); resistor layer 12 in Fig. 1) by which the circulating of the operating fluid in the cooling system is achieved. Such a heat cooling/heat distribution scheme as that featured according to claims 4 and 14, it is submitted, also avoids malfunction

concerns that are generally more typical of mechanical or even electro-mechanical schemes.

With regard to the example showing in Fig. 1 of the present invention, such heat distribution is achieved by supplying a pulse-like electric power to the resistor layers 12, intermittently, to induce fluid vibration, i.e., give vibration to the operating fluid 4. As a result of movement of the operating fluid 4 caused by the gas bubbling of the operating fluid, the heat that is generated in the electronic circuit layer 2 of the IC1 (e.g., a hot spot) becomes transferred (or diffused), which leads to a more even distribution of temperatures within the chip (see the example discussion on page 16, line 9, to page 17, line 16; see also page 17, line 16, et seq. of the Substitute Specification).

Zuo discloses a PCB assembly (e.g., 100 in Fig. 1 and 700 in Fig. 7) featuring also a heat spreader (e.g., 110; see also 720, 730 and 740 in Fig. 7). With regard to the heat spreader 110 in Fig. 1 of Zuo, means 130 is used for effecting an oscillating movement of the fluid 122 between the two ends 112 and 113 of the base plate 111 via the plural channels 120. (Column 3, lines 15-30, in Zuo.) As can be seen from the Fig. 5 illustration in Zuo, the oscillating means 130 which is integrally contained within the plate 111 is also embedded in the fluid that flows in the channels since operation thereof typically involves mechanical movement. Unlike the present invention, which strictly employs electrical means (e.g., resistor layer 5 in Figs. 4 and 5(A)-5(B) or resistor layer 12 in Fig. 1) and also forms the resistor layer as part of the chip, Zuo's scheme calls for an oscillating means that not only is embedded within the fluid that moves in the channels but is contained within the

separately formed heat spreader and not as part of the chip 160 (e.g., see IC chip 160 and the separate heat spreader 110 in Figs. 3-5 in Zuo). Even the piezoelectric device such as 730 in Fig. 7 of Zuo involves mechanical movement unlike that of the resistor layer according to the present invention, which is also contained within the chip.

Van Zant was cited for its showing that one chip microprocessors are available, in which both logical circuits and memories are contained. However, Van Zant does not overcome the deficiency of Zuo's teachings insofar as the invention according to claims 4 and 14 is concerned. That is, there's neither teaching or suggestion that would have led one of ordinary skill to modify Zuo's cooling scheme so as to achieve the semiconductor integrated circuit chip set forth in independent claims 4 and 14 and, correspondingly, also according to the dependent claims thereof, even over the combined teachings of Zuo in view of Van Zant.

II. Rejection of Claims 10 and 13 under 35 USC § 103(a) over the Combination of Zuo in View of Van Zant and O'Connor, et al. (U.S. 2002/0039280)

The combined teachings of Zuo and Van Zant are applied as in the above rejection.

O'Connor was cited, allegedly, as disclosing the set forth "... temperature detecting means ...". However, O'Connor likewise fails to disclose or suggest a cooling scheme within a chip in the manner as that presently set forth. In fact, even if one of ordinary skill would have considered the combined teachings of all three such references, the present invention as set forth in claims 10 and 13, which are inclusive of the above-discussed featured aspects in base claim 4, could still not have been realizable.

Therefore, in consideration of the above supportive discussion/rebuttal arguments, withdrawal of the outstanding rejections as well as favorable action on the pending claims, i.e., claims 4-14 and 21, and an early formal Notification of Allowance of the above-identified application is respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR §1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (Case No. 520.43306X00) and please credit any excess fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

Larry N. Anagnos
Registration No. 32,392

LNA/mlh
Telephone: (703) 312-6600
Facsimile: (703) 312-6666